



CAPSTONE TURBINE
CORPORATION

CAPSTONE AIR PACK INSTALLATION PROCEDURE



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Publisher

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USING THIS DOCUMENT

This document provides specific instructions on how to properly install and interface the Capstone Air Pack with a C65 MicroTurbine.

This document should be used after the: a) access areas are reserved and documented, b) kit inspection/inventory is complete, c) safety measures are in place, and d) necessary drawings are at hand, as required. Read this document completely before starting work.

An Installation Completion Checklist (Table 3) with a column for signoff/initials is provided within this document to record setup and verification of actual installation steps. A signed copy of the checklist must be provided to Capstone Customer Service upon completion of installation. Refer to the back of this document for Capstone contact information.

SYMBOLS

There are three very important symbols used in this document: Warnings, Cautions, and Notes. Warnings and Cautions alert you to situations and procedures that can be dangerous to people and/or cause equipment damage. Notes provide additional information relating to a specific operation or task. These symbols are as follows:

WARNING	A Warning means that personal injury or death is possible.
CAUTION	A Caution means that damage to the equipment is possible.
NOTE	A Note is used to clarify instructions or highlight information that might be overlooked.

SAFETY PRECAUTIONS

WARNING

Do not operate the MicroTurbine, the Air Pack or related equipment if a fuel leak is detected.

Read and understand the Safety Information section of the Capstone MicroTurbine™ User's Manual (400001 for C60 or 400017 for C65) and the User's Manual Addendum A (400020) before working on Capstone MicroTurbines, the Air Pack and related equipment. Failure to obey all safety precautions and general instructions may cause personal injury and/or damage to the equipment. Any work on fuel or electrical interfaces or internal Air Pack equipment is restricted only to a certified Capstone Authorized Service Provider (ASP). User personnel must not open or work on any Capstone equipment, unless they have successfully completed the Capstone ASP training course.

INTRODUCTION

The Air Pack is installed on the C65 Liquid Fuel (LF) model MicroTurbine (MT). It is mounted to the back of the C65 enclosure, though it is not a part of the MicroTurbine itself. The Air Pack provides air to the turbine during start and low power operations. Figure 1 shows a MicroTurbine installation with the Air Pack.

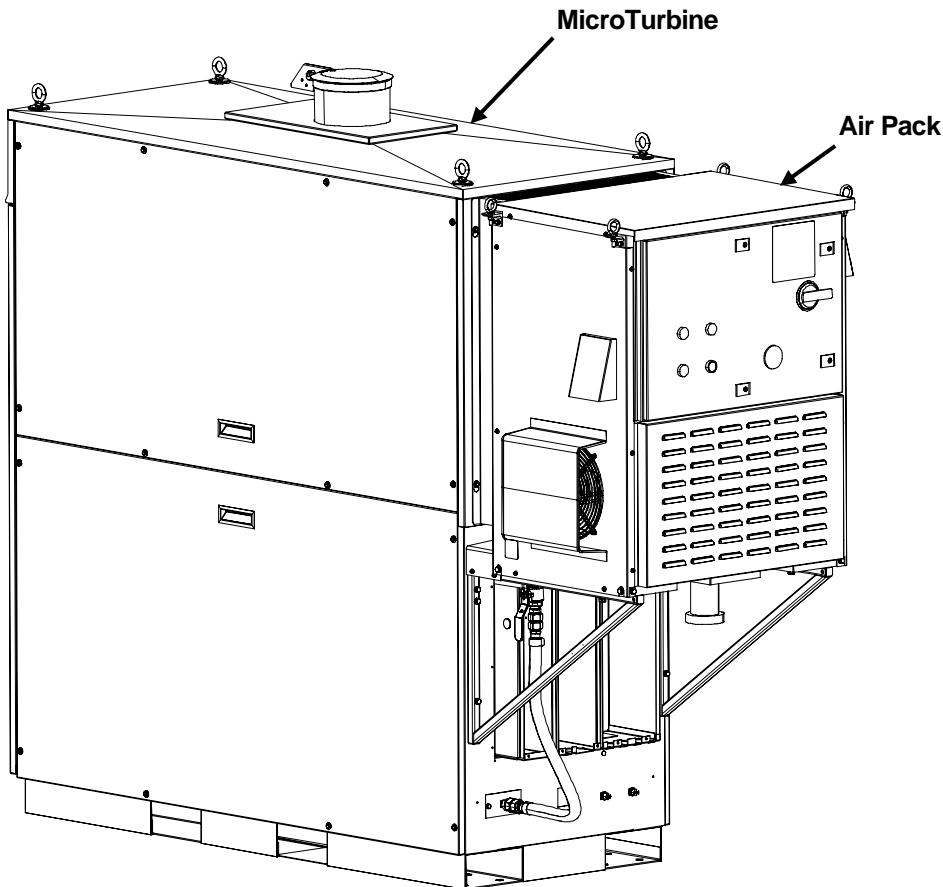


Figure 1. MicroTurbine with Air Pack

Configuration Options

The Air Pack is available only in a DC version that uses power from the MicroTurbine to operate.

The customer can choose to connect the MicroTurbine to facility air rather than install the Air Pack. This requires the External Air Assist Kit to provide the interface between the MicroTurbine and the facility air supply. It also requires that the facility air is able to supply the necessary 10 cfm (cubic feet per minute) air input at 65 psig to the turbine. Refer to Work Instruction 440172 for procedures to install the External Air Assist Kit.

INSTALLATION OVERVIEW

The installation of the Air Pack involves mechanical mounting, an electrical harness connection, including DC power interface, and an air line outlet connection from the Air Pack to the MicroTurbine.

The Air Packs are provided as "kits." Each kit includes the required mounting hardware and an air outlet kit for installation and connection to the MicroTurbine (MT). Consult factory or your authorized Capstone distributor, if needed, to confirm which type of MTs are installed at a specific site.

NOTE	The Air Pack Assembly weighs approximately 420 pounds.
NOTE	Ensure 31 inches of rear service clearance to allow full swing/access of the 27-inch Air Pack door. Refer to O&I Drawing 524089-100 for clearance information and dimensional requirements.

Tools Required

Use the Capstone's Recommended Tools (400003) or equivalent to perform procedures listed in this document. Additional tools/materials required are as follows:

- Strap cutters
- 2" Open End Wrench
- 1-1/16" Open End Wrench
- 1-1/4" Open End Wrench
- 12" Adjustable Wrench
- 15" Adjustable Wrench
- 15" Crescent Wrench
- Socket Drive
- 7/16" Wrench
- 7/16" Socket
- 17mm Wrench
- 17mm Socket
- 13mm Socket
- 8mm Socket
- Spanner bar for lifting Air Pack with eyebolts
- Chain or cable rated for 1000 lbs minimum for lifting Air Pack
- Pipe Wrench
- Torque Wrench
- Wire Stripper
- Flat-head Screwdriver
- Gas pipe Teflon thread tape
- Soldering iron, solder, and tinning flux
- Soap solution / brush for leak detection

Torque Requirements

Torque requirements for fasteners used in this document are as follows:

- M8 Fasteners: Up to 18 lb-foot (24.4 Nm) \pm 5%
- M10 Fasteners: Up to 32 lb-foot (43.4 Nm) \pm 5%

Air Pack Installation Components

Components used for installing the Air Pack are listed in Table 1.

Table 1. Air Pack Installation Components

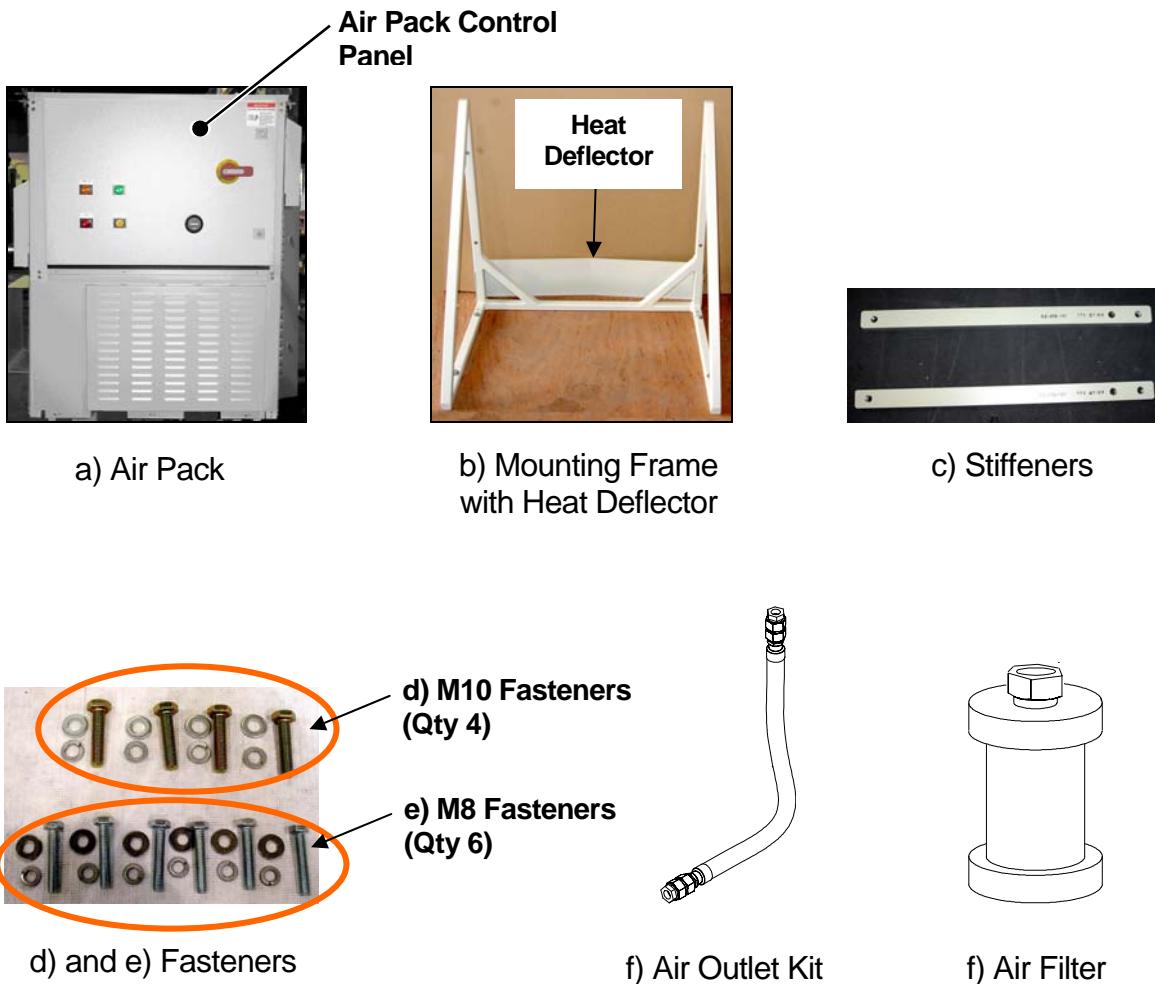
Part Number	Description	Comment
523765-100	Air Pack Assembly, DC w/Outlet Kit	Includes air outlet kit and air filter.

INSTALLATION

Mechanical Installation

1. Carefully remove the shrink wrap, packing material and shipping straps without damaging side panels and vent covers.
2. Identify the Air Pack Kit parts as follows:

NOTE	The following components are included as part of the complete Air Pack Kit. Confirm that all components are present before proceeding. The stiffeners and fasteners may be found inside the Air Pack control panel – turn the red handle switch to the Off position to open the panel door.
-------------	---



CAUTION When drilling holes in the MT rear panel, use care to not damage the cable assemblies that are behind the panel.

3. If holes are not already provided in the MT rear panel, drill the holes as follows:
 - a. Locate and mark the 32-3/8" vertical distance on the left and right sides on the back of the MT (see Figure 2). Use other dimensions as reference.

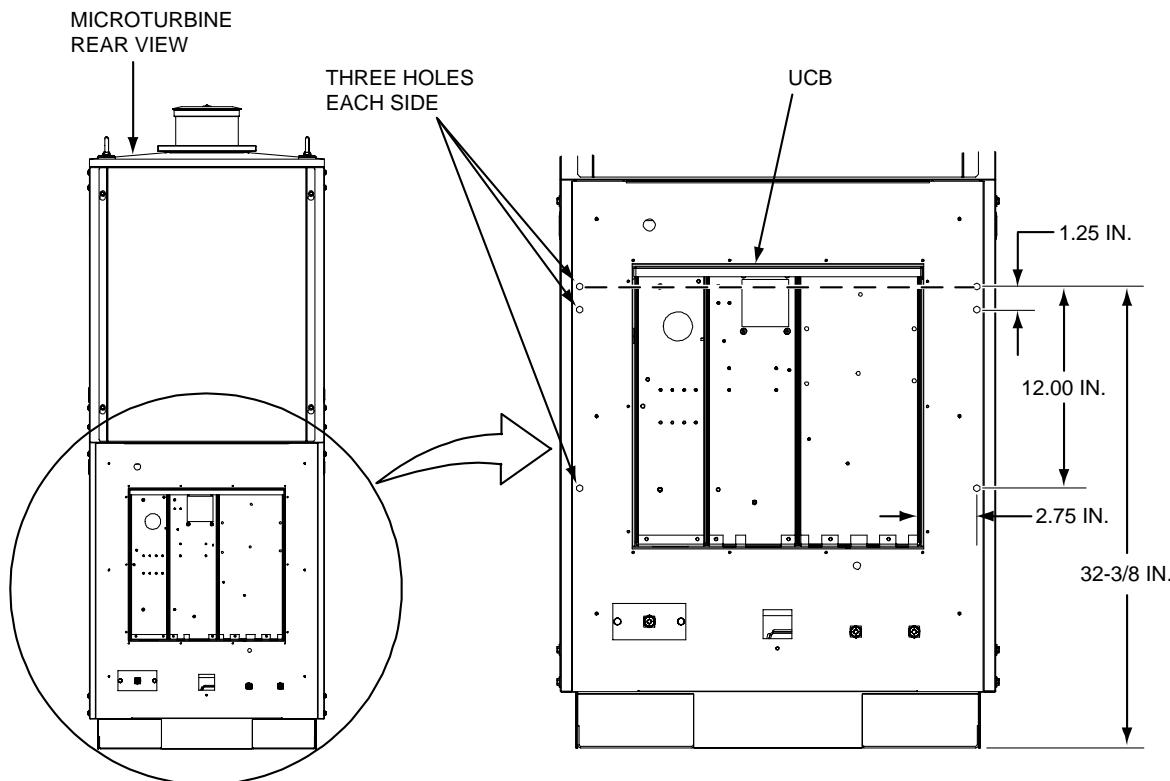


Figure 2. Mounting Frame Hole Locations on Back of MicroTurbine

- b. Using the Mounting Frame as a template (see Figure 3), align the two upper mounting holes with the 32-3/8" line. Make sure the mounting frame is at equal distances from right and left edges of MT, and mark the locations of the six holes.
- c. Remove the side panels from the MicroTurbine.
- d. Carefully drill six holes in the rear panel using size 11/32 drill bit. Place a block of wood or other material between the panel and the cable assemblies to prevent drilling into the cable assemblies.

4. If not already done, remove the side panels from the MicroTurbine. Install the mounting frame to the back of the MicroTurbine with the six M8 fasteners, flat washers, lock washers, and stiffeners using a 13mm wrench and socket. The stiffeners are installed inside the rear vertical MicroTurbine supports (see Figure 3). Remove the packing material from the mounting frame.



Figure 3. Installing Mounting Frame to MicroTurbine

5. For ICHP Systems Only: Loosen the mounting screws for the rain hood at the back of the Heat Recovery Module (HRM), and lift the rain hood off of the HRM. Also, remove the pipe Tee fitting together with the vent screen and set aside (see Figure 4).

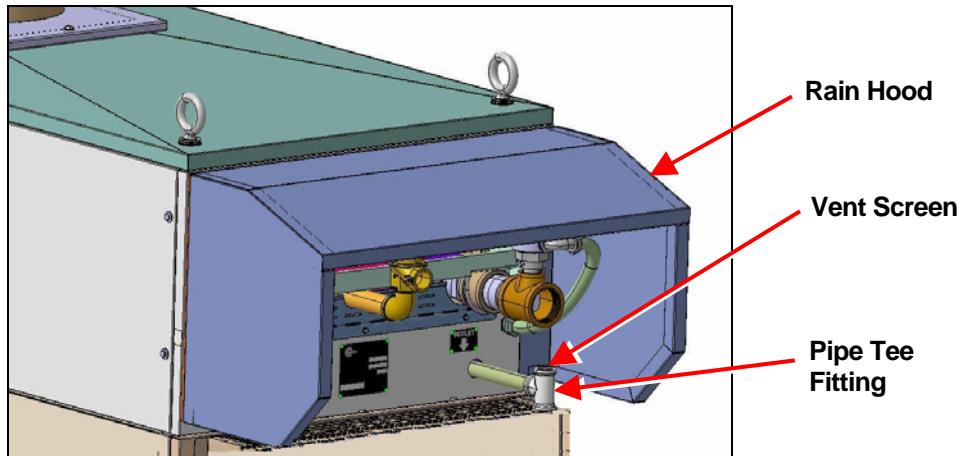


Figure 4. HRM Rain Hood

WARNING	The Air Pack Assembly weighs approximately 420 pounds. Use appropriate lifting equipment. At least one person is recommended to help keep the Air Pack steady during lifting and positioning operation.
----------------	---

6. Using appropriate lifting equipment, lift the Air Pack using the four eyebolts (see Figure 5) until it completely clears the wooden pallet. Use spanner bars to maintain load vertically on eyebolts. Do not exceed a 22° angle from vertical on the lifting chain or cable. If installing the Air Pack on an ICHP system, make sure the lifting equipment clears the top of the Heat Recovery Module (HRM).



Figure 5. Lifting the Air Pack

7. Lift the Air Pack and carefully align it above the mounting frame, paying special attention to the outlet valve and inlet filter under the Air Pack and the hanging conduits. Route the two conduits through the corner of the mounting frame, near the inlet filter, as you lower the Air Pack. See Figure 6. Install the Air Pack in place with the M10 fasteners, flat washers, and lock washers using a 17mm socket and wrench.

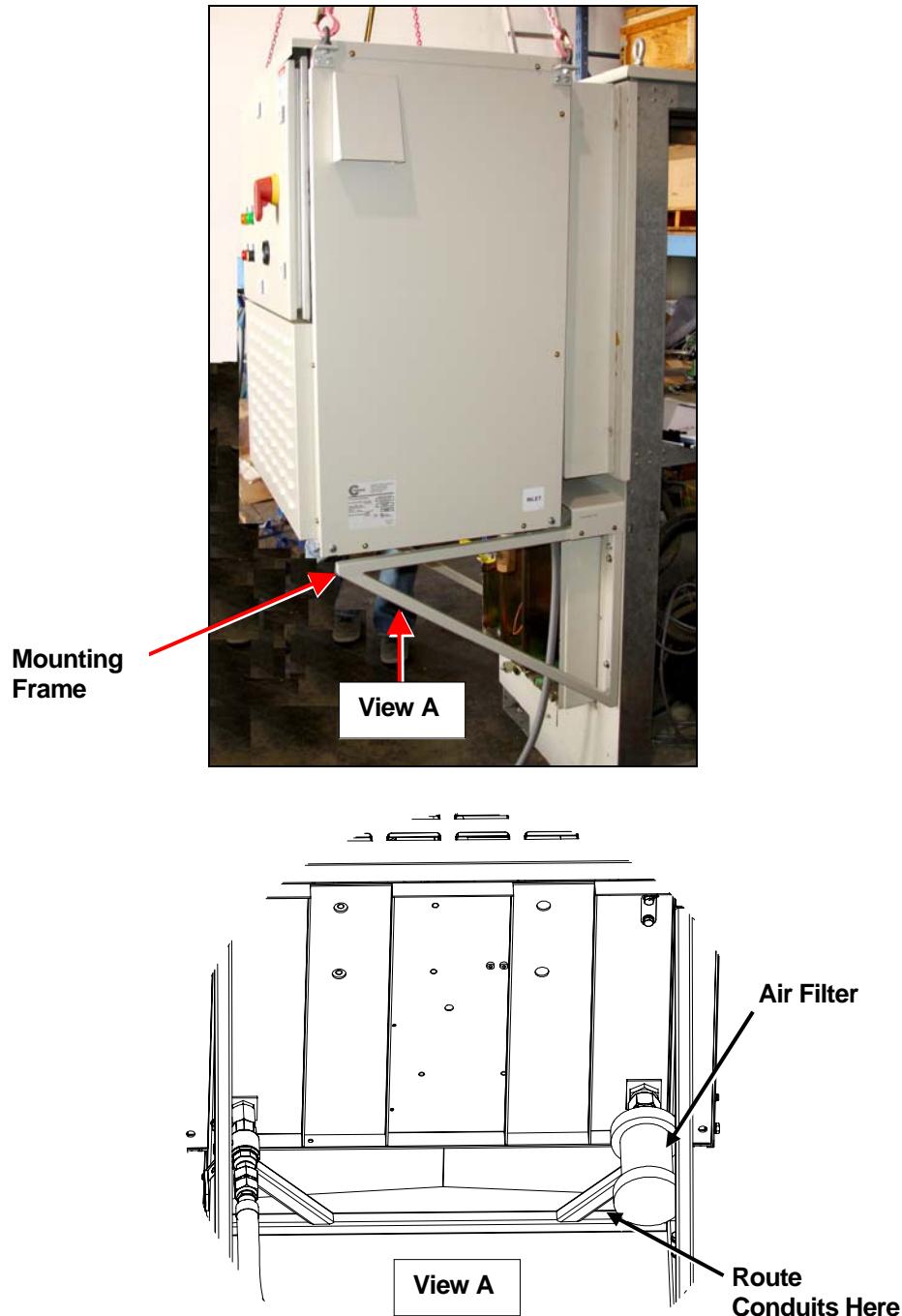


Figure 6. Installing Air Pack on Mounting Frame

8. If not already installed, install the handle on the outlet isolation valve, using the nut and star washer on the valve body.
9. For ICHP Systems Only:
 - a. Re-install the rain hood at the back of the Heat Recovery Module (HRM). See Figure 7. Tighten the rain hood mounting screws.

- b. Use NPT sealant on the following NPT connections. Decide which side (left or right) of Air Pack is convenient for extending the drain pipe, and install a 90°, $\frac{3}{4}$ NPT fitting (not supplied by Capstone) to the drain pipe. Install an extra piece of $\frac{3}{4}$ NPT pipe, threaded at both ends (not supplied by Capstone) to the 90° fitting. Install the pipe Tee fitting to the end of the extended pipe with vent screen facing upwards (not shown on Figure 7).

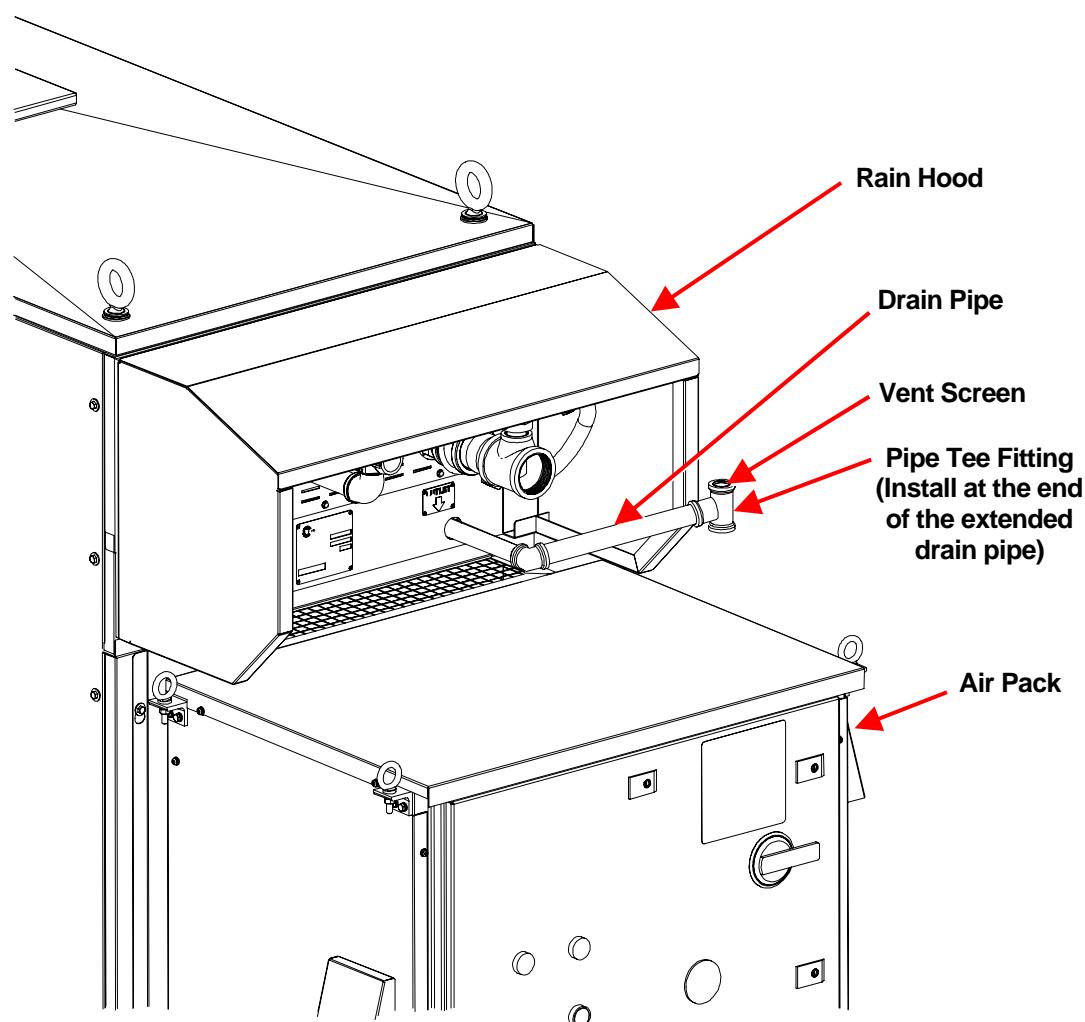


Figure 7. View of HRM Showing Rain Hood and Drain Pipe

10. Install the air outlet kit and air filter as shown in Figure 8. Refer to O&I Drawing 522944-100 for installation details. Use gas rated yellow tape or equivalent on all threaded joints.

NOTE	The gas-rated (yellow) thread tape (or equivalent) must be used on all threaded joints. It should be wrapped 2 to 4 times around the threads in the direction of the threads. The first (outermost) thread must be left bare.
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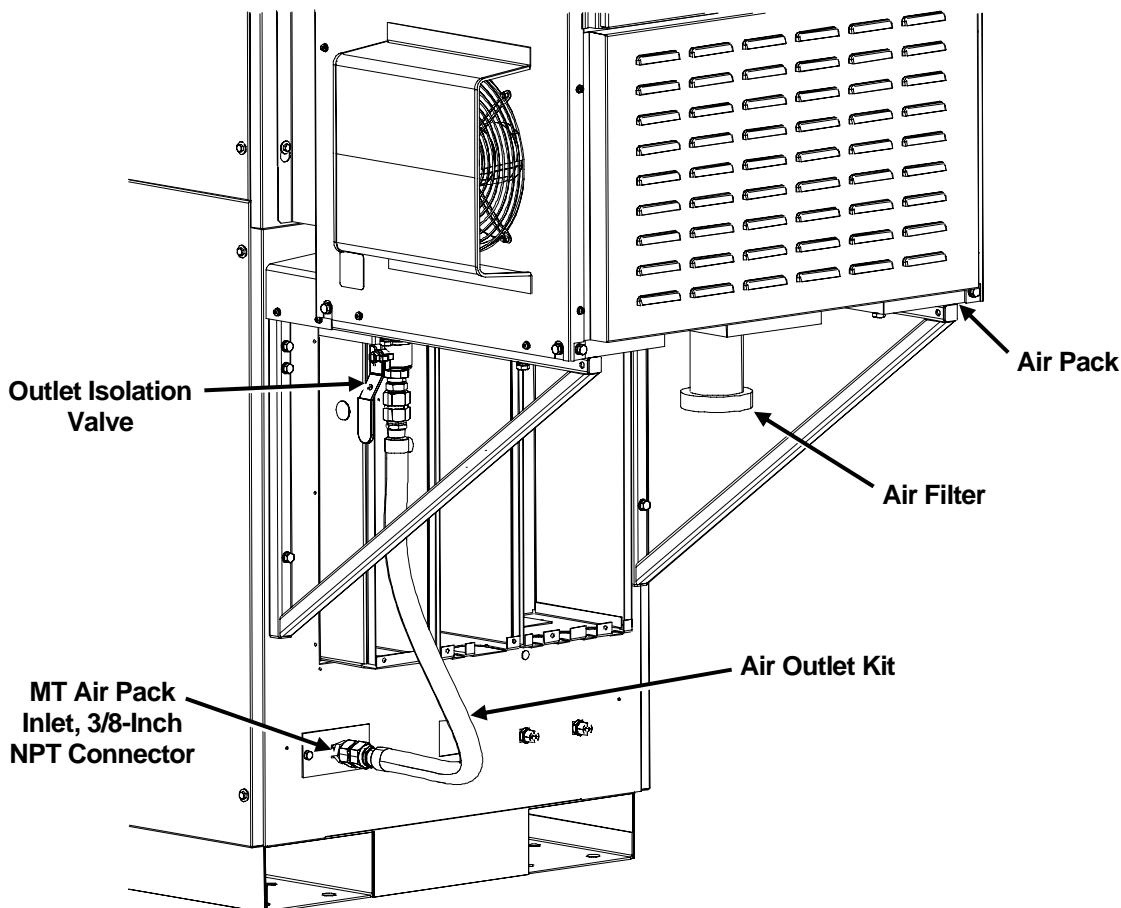


Figure 8. Installing Air Outlet Kit

11. Close outlet isolation valve.
12. Re-install MicroTurbine's side panels.
13. Remove UCB panel covers.

Software Setup

The following steps require a qualified Capstone ASP to perform.

CAUTION	Program the MicroTurbine software before making any electrical connections to the Air Pack to prevent damage to the MicroTurbine.
----------------	--

Program the MicroTurbine software as follows:

1. Ensure that there are no electrical connections between the MicroTurbine and the Air Pack.
2. Power up the MicroTurbine (only energize electrically, but do not start the turbine).
 - a. If the MT with the mounted Air Pack is in Grid Connect mode, ensure the utility facility AC breaker is on. If the MT is in Stand Alone mode, open the front door and turn on the battery breaker. Close the front door and press the “BATT START” button on the display panel to wake up the system.
 - b. Connect a laptop PC with CRMS software to the UCB Maintenance port J3 or User port J5. After successful login to the MT using CRMS, select the MicroTurbine window, then select the Relays window.
3. Program the output relays as follows:

NOTE	The Capstone software must be set up to treat the Air Pack as an External Auxiliary Load. Any of the output relays may be configured to perform this function; however, the specified wiring connections demonstrate the use of Relay #1.
-------------	---

Using CRMS, proceed as follows:

- a. On the UCB Relays menu, Relay #1 submenu, set EXT LOAD to ACTIVE CLOSED.
- b. On the System Settings menu, Fault Input #1 submenu, set Fault Input #1 to ENABLE and ACTIVE CLOSED. On Fault Input #1 submenu, set SSL to 3 and time to 12 seconds. This fault input will be used to transmit fault indication from the Air Pack to the MicroTurbine.

4. Power down the MicroTurbine as follows:
 - a. Reverse Step 2a above, i.e., open the utility breaker for Grid Connect mode, or open the MicroTurbine battery breaker for Stand Alone mode.
 - b. Lock out the utility breaker or the battery breaker, as applicable.
 - c. Wait five minutes for any capacitive voltage to dissipate.

Electrical Connections

1. Make the Air Pack DC connections as directed in the following steps.

WARNING	Verify that no voltage exists in the High Voltage DC bay before any installation work begins.
----------------	---

- a. Connect the $\frac{1}{2}$ " liquid-tight flexible conduit with three wires (from the Air Pack) to the bottom of the High Voltage DC (HVDC) power bay on the UCB.
- b. For UCBs without Precharge Assembly in HVDC Bay: Connect the red and black power wires to the mating Anderson connectors (black to black and red to red). Connect the green wire to the ground stud in HVDC bay wall using an 8mm socket wrench. Refer to Figure 9 and Figure 10 as required.

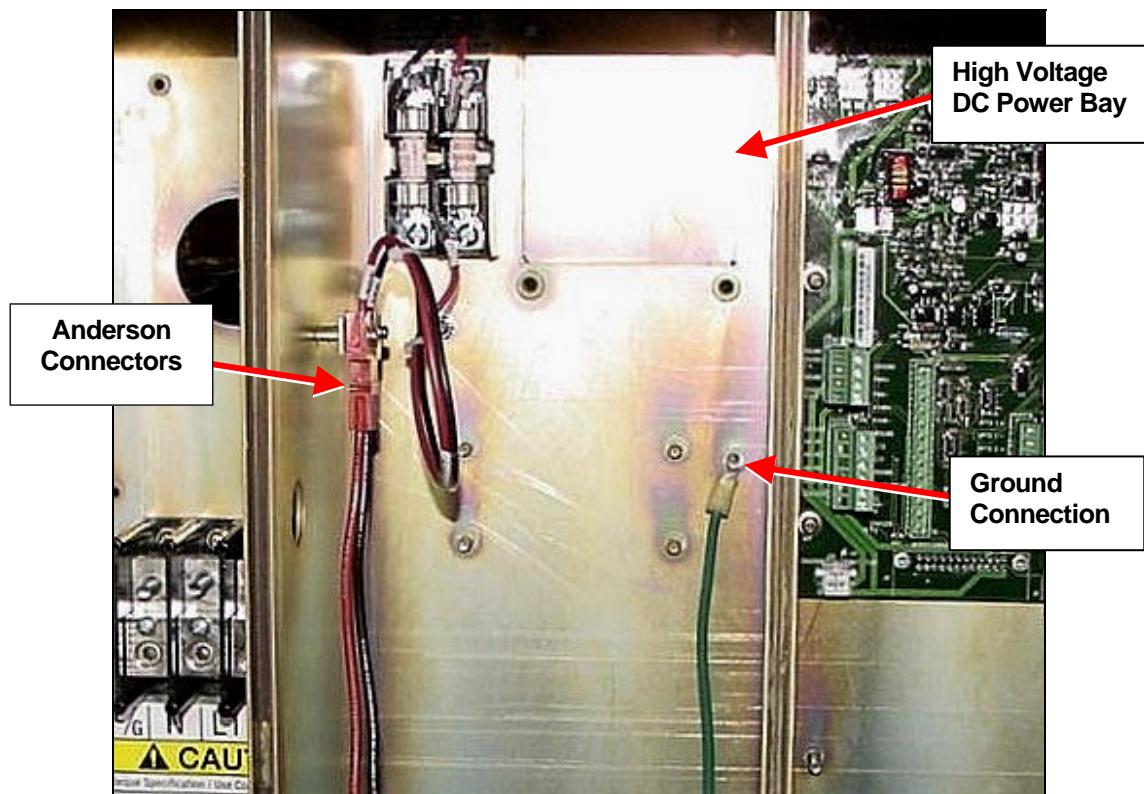


Figure 9. Connecting Conduit with 3 Wires to UCB (without Precharge)

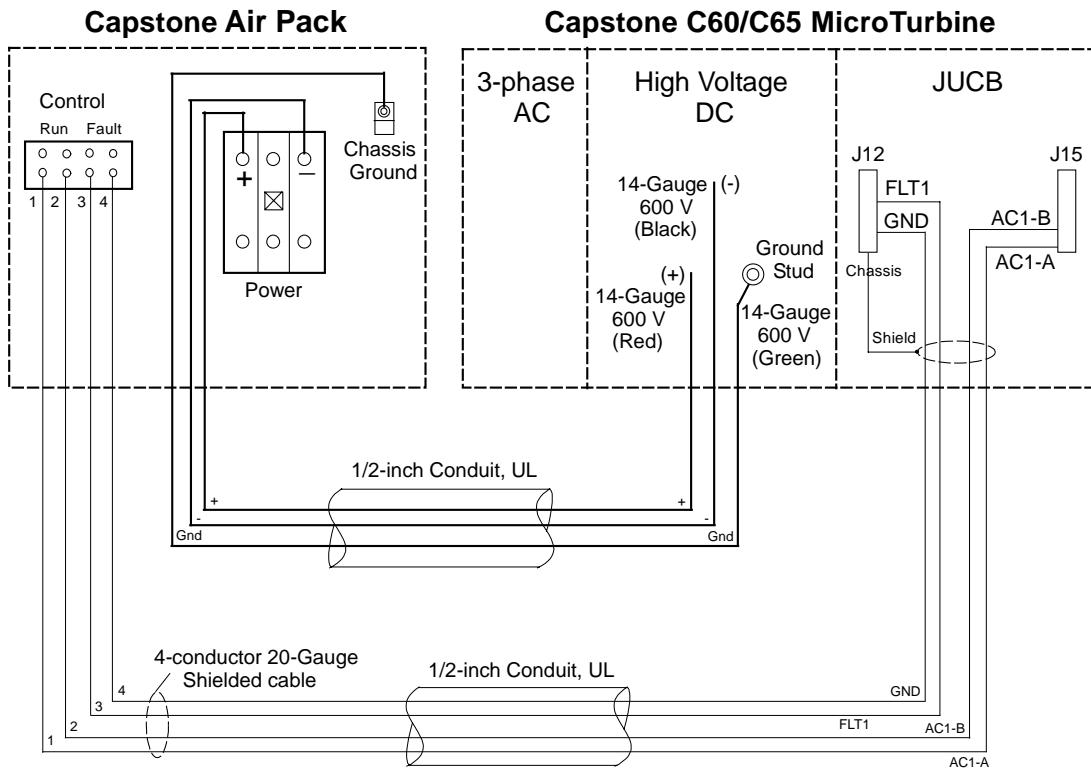


Figure 10. Wiring Between DC Air Pack and UCB (without Precharge)

CAUTION

Ensure that the red wire is connected to the left terminal and black wire is connected to the right terminal, and no bare wire is exposed after connecting the red and black wires, as shown in Figure 11.

- c. For UCBs with a Precharge Assembly in HVDC Bay: Cut away the Anderson connectors from the red and black DC power wires from the Air Pack. Strip each wire end by $\frac{1}{2}$ inch, twist the wire strands and tin the stripped area. Referring to Figure 11, insert the red wire fully into the left terminal and make sure that no bare wire is exposed (cut away as necessary) and tighten in place. Repeat for black wire but insert it into the right terminal. Connect the green wire to the ground stud in HVDC bay wall using an 8mm socket wrench.

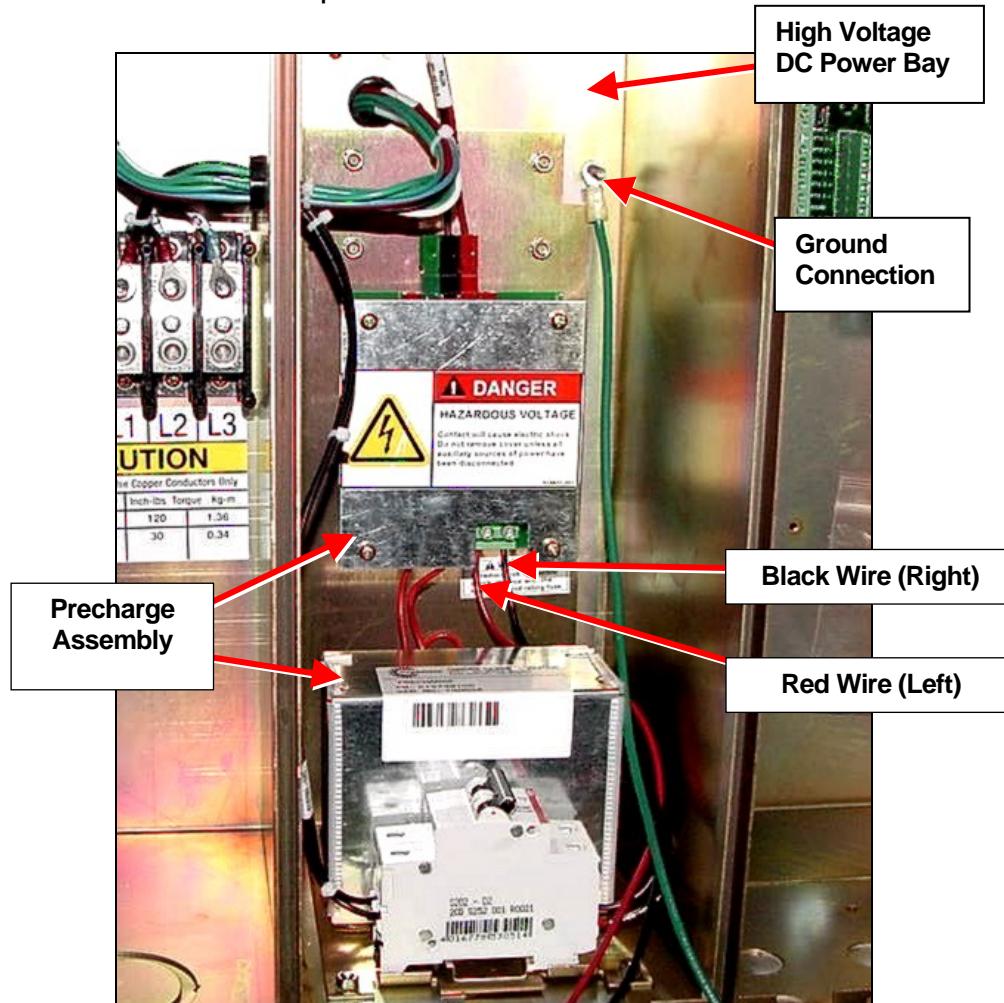


Figure 11. Connecting Conduit with 3 Wires to UCB (with Precharge)

- d. Install the flexible conduit with four control signal wires to the bottom of the MT Communications bay on the UCB (see Figure 12). The four wires are labeled with the connection locations. Connect according to Table 2. Refer to Figure 10 and Figure 13 for UCB terminal locations.

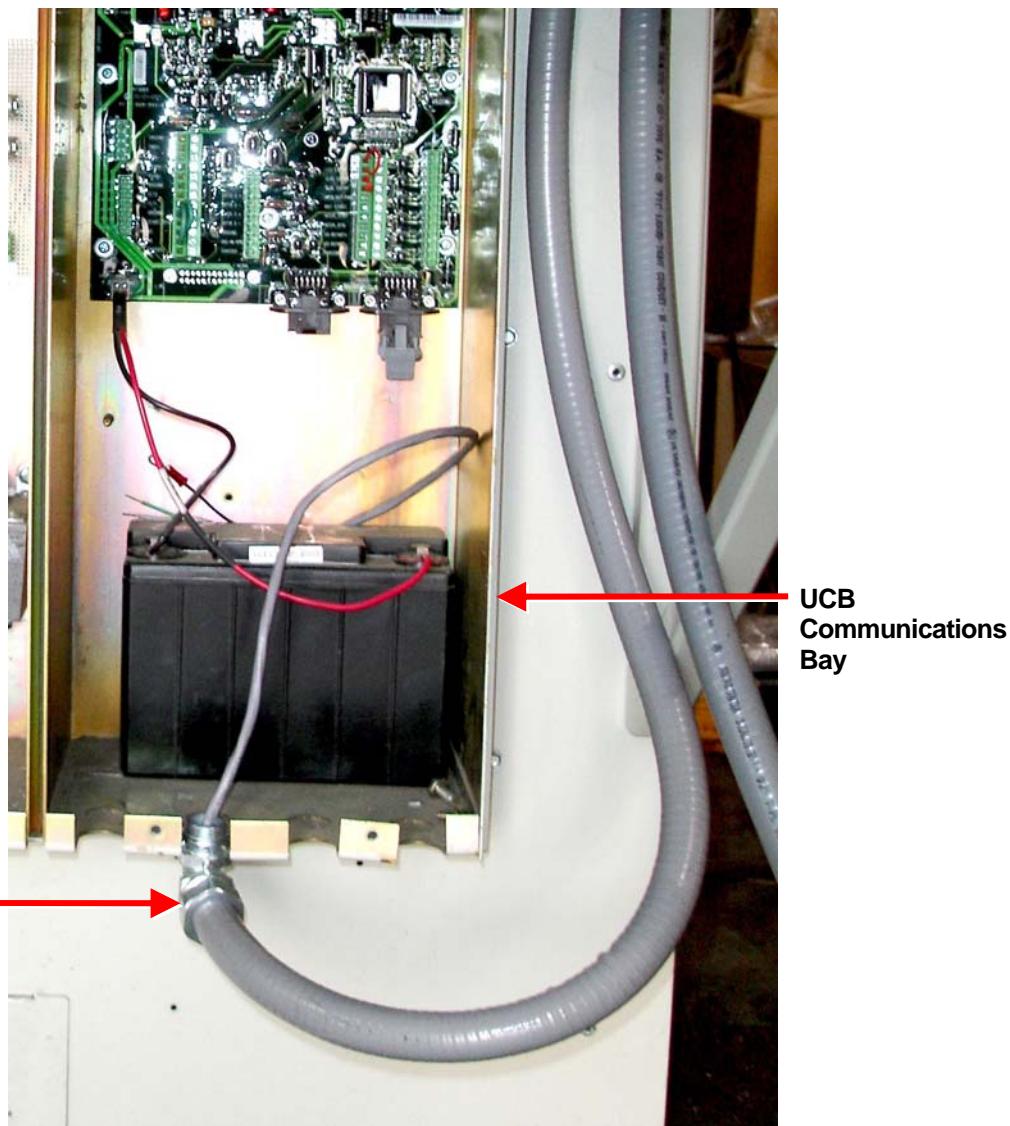


Figure 12. Installing Conduit with 4 Signal Wires to Bottom of UCB

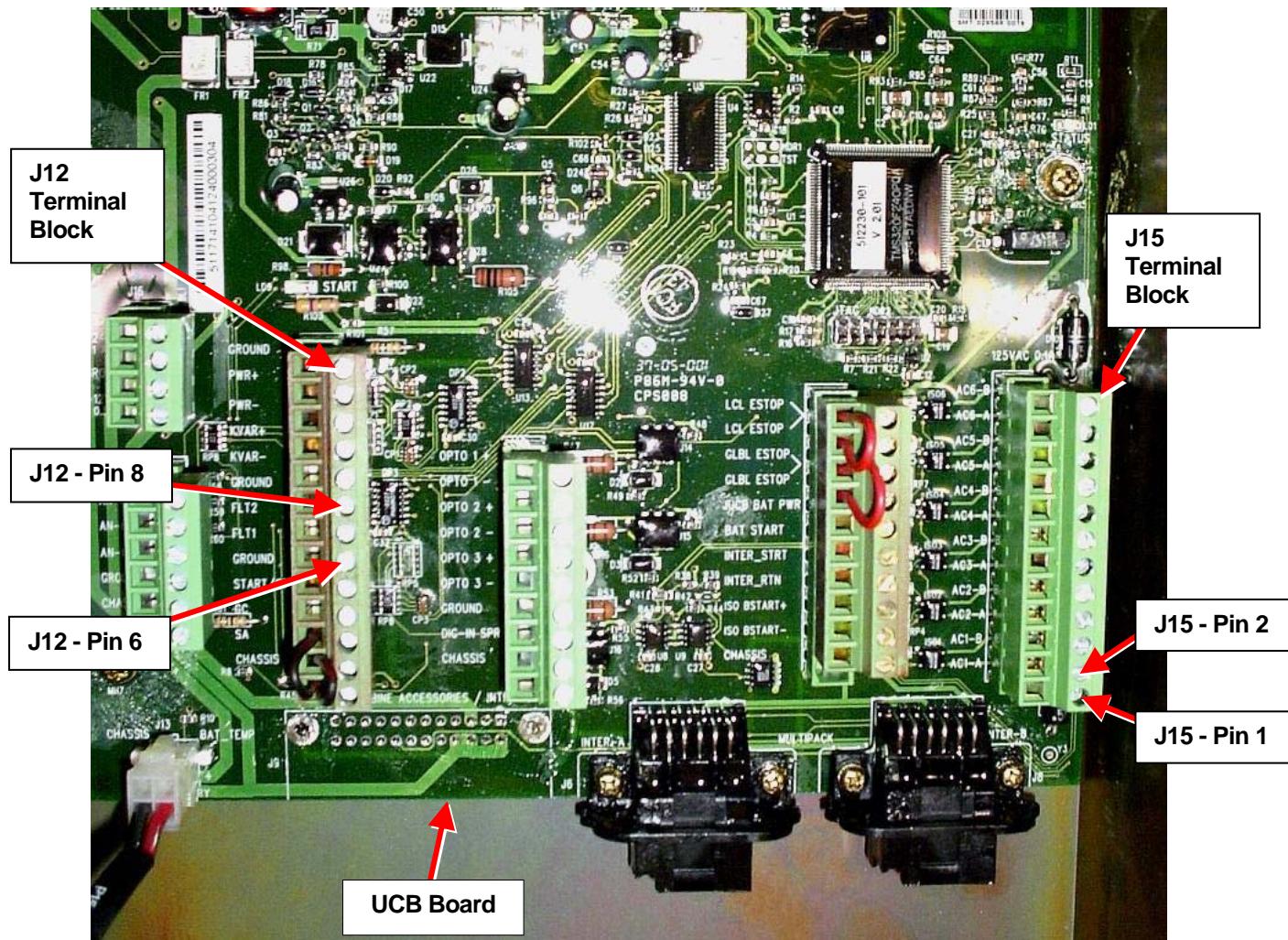


Figure 13. Connectors J12 and J15 on UCB Board

Table 2. UCB Board Wiring Connections

Air Pack Control Wire Color	UCB Terminal
Red	J15-Pin 1 (AC1-A)
Black	J15-Pin 2 (AC1-B)
Green	J12-Pin 8 (Ground)
White	J12-Pin 6 (FLT1)
Bare Wire	Stud on bay wall

Closeout

1. Replace the UCB covers.
2. Visually check overall installation.
3. Lock the control console door using the locking key located near the upper left corner inside the console. Store the key in a safe place.

CAUTION	The commissioning procedures must only be done by a Capstone Authorized Service Provider (ASP).
----------------	---

4. Perform the Commissioning Procedure and Checklist contained in Appendix A.

Installation Completion Checklist

Table 3 is a checklist to be filled as the installation progresses, noting item complete signoffs and remarks of problems/mitigations. This document should be provided to the customer and Capstone along with a signed Commissioning Checklist. See Appendix A.

Table 3. Installation Completion Checklist

Item #	Description	Complete		Remarks
		Initials	Date	
1	Power down MicroTurbines.			
2	Carefully remove shrink wrapping/shipping straps and verify all parts are present per Step 2 of Mechanical Installation section.			
3	Locate, mark, and drill frame per Step 3 (if required), then install mounting frame/heat deflector assembly to MicroTurbine per Step 4 of Mechanical Installation section.			
4	Lift Air Pack so it completely clears the pallet per Step 6 of Mechanical Installation section.			
5	ICHP Systems Only: Remove the rain hood on the HRM per Step 5 of Mechanical Installation section.			
6	Install Air Pack on the mounting frame, per Step 7 of Mechanical Installation section.			
	If necessary, install the handles on the outlet isolation valve per Step 8 of Mechanical Installation.			
8	ICHP Systems Only: Re-install the rain hood on the HRM per Step 8 of Mechanical Installation section.			
9	Install the air outlet kit per Step 10 of Mechanical Installation section.			
10	Clear the area per Step 11 of Mechanical Installation section.			
11	Re-install MicroTurbine side panels per Step 12 of Mechanical Installation section.			
12	Remove UCB panel covers per Step 13 of Mechanical Installation section.			

Item #	Description	Complete		Remarks
		Initials	Date	
13	Perform Software setup before any Air Pack electrical connections are made, followed by power down of MT.			
14	Using a voltmeter, verify that no voltage exists in the High Voltage DC bay.			
15	Make Electrical Connections per Step 1 of section, for DC Air Pack.			
16	Connect communication wiring per Step 1.d of the Electrical Connections section.			
17	Replace UCB covers per Step 1 of Closeout & Operational Check section.			
18	Visually check overall installation.			

APPENDIX A

AIR PACK COMMISSIONING PROCEDURE AND CHECKLIST

PURPOSE

This Commissioning Procedure and Checklist presents information sufficient to allow an Authorized Service Provider (ASP) to properly verify that the Air Pack has been installed and configured correctly.

Before taking responsibility of the system and submitting the Commissioning Checklist to Capstone, the ASP must perform and satisfy the procedures in this document.

COMMISSIONING PROCEDURE

Perform the commissioning procedure as described in the following paragraphs.

Site Evaluation

1. Complete a thorough inspection of the Air Pack and all interfaces (electrical, mechanical, and air).
2. Make any adjustments or additions required to the existing installation before commissioning the system.

Mechanical Procedures

1. Air Pack door clearance: Ensure 31 inches of clearance to allow full swing/access of the 27-inch Air Pack door.
2. Side Clearances: Ensure that there is a minimum of 30 inches of clearance on the right and left sides of the Air Pack.
3. Verify air tight integrity from the Air Pack through to the MicroTurbine inlet.

Electrical Procedures

1. Verify the chassis of the Air Pack enclosure is connected to a proper ground in the UCB as described in the Electrical Connections section.
2. Ensure the power and control terminals are properly connected per interface definition in the Electrical Connections section.
3. Ensure the control wires run in a separate conduit from the power cables.

Operational Procedures

WARNING	Do not ever start the MicroTurbine with the fuel supply OFF.
----------------	--

1. Configure the Air Pack and MT for power up.
2. Make sure that the manual fuel shut-off valve(s) on the MicroTurbine are open.
3. Open the outlet isolation valve at the Air Pack.
4. Verify that the initial manual priming of the MicroTurbine has been done as described in the MicroTurbine User's Manual Addendum A (400020).
5. Initiate a START. Verify the MicroTurbine starts and loads normally.
6. Check air fittings for leaks with leak detecting fluid, i.e. soapy water. If an air leak is detected from the Air Pack or air plumbing, shut down MicroTurbine and all power, and tighten/mitigate all leaks. Resume procedure.
7. After a 5-minute run, initiate a STOP command. Verify the MicroTurbine shuts down normally.
8. Initiate a START and run at full power for 15 minutes. Verify Air Pack and MicroTurbine(s) operate together normally.

ASP Responsibilities

1. Present the end user (owner/operator) with the MicroTurbine User's Manual Addendum A (400020) shipped with the system.
2. Discuss general safety precautions regarding electrical, fuel, exhaust, and acoustics including any site-specific details, electrical and fuel breaker and shutoff locations.
3. Explain the expected performance for the Air Pack as contained in the MicroTurbine User's Manual Addendum A (400020).
4. Explain Air Pack Preventive Maintenance as contained in the MicroTurbine User's Manual Addendum A (400020).
5. Provide Capstone contact information.

COMMISSIONING CHECKLIST

(Page 1 of 2)

NOTE	The Commissioning Checklist must be completed AFTER performing all of the steps on the Commissioning Procedure above.
NOTE	Upon completion of commissioning of the Air Pack system, provide a signed copy of the Commissioning Checklist to end user, and provide the signed original to Capstone.
NOTE	A separate Commissioning Checklist form must be completed for each Air Pack commissioned.

<input type="text"/> 65X-XXX-XXXX (Catalog No.) - C65	<input type="text"/> 523765-1XX (Air Pack)
MT Serial No. (one with Air Pack):	Air Pack Serial No.:
Commissioning Date:	
Customer Information	
Unit Owner:	Contact Name:
Contact E-Mail:	Contact Phone:
Contact Fax:	Location:
Address:	City:
State:	Zip Code:
Country:	Site Utility:
Installation Information	
Site Contact Cell Phone #:	Site Contact Fax:
Site Contact E-Mail:	Modem Phone:
IP Address:	System Part No.:
Supply Fuel Pressure:	Site Elevation:
OEM Part No/Serial No (If applicable):	Distributor:
ASP Company:	ASP Technician:
ASP Cell Phone #:	ASP E-Mail:
Miscellaneous Information (dates, etc):	
Customer Signature:	
ASP Signature:	

COMMISSIONING CHECKLIST (Cont'd)

(Page 2 of 2)

Inspections

Mechanical

1. Does the installation meet service/access specifications?	Yes <input type="text"/>	No <input type="text"/>
2. Has the entire air system from the Air Pack through to the MicroTurbine inlet(s) been tested and fixed for leaks under Air Pack operating conditions?	Yes <input type="text"/>	No <input type="text"/>
3. Is this an Indoor or Outdoor Installation and is it in a salt air environment?	Indoor <input type="text"/> Outdoor <input type="text"/> Salt air <input type="text"/>	
4. Does the installation meet service specifications including the 31-inch clearance zone?	Yes <input type="text"/>	No <input type="text"/>
5. Does the enclosure and conduit installation meet all mechanical and code requirements?	Yes <input type="text"/>	No <input type="text"/>
6. Is installation properly corrosion proofed, especially if in salt air environment?	Yes <input type="text"/>	No <input type="text"/>

Electrical/Communications

1. Are control wires run in a separate conduit from the power cables?	Yes <input type="text"/>	No <input type="text"/>
2. Are the proper color wires including chassis ground connected to corresponding DC/ground terminals of the MicroTurbine? (Follow all safety precautions)	Yes <input type="text"/>	No <input type="text"/>
3. Are the metallic conduits for power wiring grounded at the penetration points for both the MicroTurbine and the Air Pack?	Yes <input type="text"/>	No <input type="text"/>
4. Are the metallic conduits for the control wiring grounded at the penetration points for both the MicroTurbine and the Air Pack?	Yes <input type="text"/>	No <input type="text"/>
5. Are the DC power cables inside liquid tight UL conduit?	Yes <input type="text"/>	No <input type="text"/>

Responsibility

It is the responsibility of Capstone to make these procedures available to the Authorized Service Providers so they can successfully complete this task.

It is the responsibility of the Authorized Service Providers to read this document, understand its contents, and effectively complete the procedures.

It is the responsibility of the Authorized Service Providers to submit the signed original of the Commissioning Checklist to Capstone within 30 days of commissioning for activation of warranty terms.

REFERENCE DOCUMENTS

Table 4 lists applicable Capstone reference documents.

Table 4. Reference Documents

Document No.	Document Title
400001	C30/C60 MicroTurbine User's Manual
400017	C65 MicroTurbine User's Manual
522944-100	O&I Drawing, Liquid Fuel Stand Alone, C65
400020	MicroTurbine User's Manual Addendum A

CAPSTONE CONTACT INFORMATION

If questions arise regarding Air Pack installation, please contact Capstone Turbine Corporation for assistance and information:

Capstone Applications

Toll Free Telephone: (866) 4-CAPSTONE or (866) 422-7786

Fax: (818) 734-5385

E-mail: applications@capstoneturbine.com

Capstone Service

Capstone Technical Support

Toll Free Telephone: (877) 282-8966

Service Telephone: (818) 407-3600 • Fax: (818) 734-1080

E-mail: service@capstoneturbine.com

Capstone Technical Support (Japan)

Service Telephone: (818) 407-3700 • Fax: (818) 734-1080

E-mail: servicejapan@capstoneturbine.com